Chapter 6
Laboratory Design, Sampling, and Flow Monitoring

6-1. General

The purpose of a well-equipped and properly operated laboratory is to control and monitor the operation of the wastewater treatment facility. Sampling and flow monitoring facilitate compliance with regulatory monitoring requirements and process control. For small-scale treatment facilities, however, on-site laboratory facilities may not be cost effective. The decision to construct on-site laboratory facilities is primarily economic. Commercial laboratories, as well as centrally located Engineer Division or District laboratories, may prove to be more cost effective. For a detailed description of responsibilities, policies, materials and chemistry testing, and analytical services capabilities of the major subordinate commands (MSC) laboratories, see ER 1110-1-8100. In addition, ER 1110-1-261 describes responsibilities and procedures for laboratory testing performed by and for the Corps of Engineers District Offices.

6-2. Laboratory Design

If included as a facility feature, the laboratory should be located on the ground floor or in the basement, preferably with a northerly exposure to light; the laboratory should have a solid floor and should be free of traffic and machinery vibrations.

a. Space. The first criterion with regard to laboratory facilities is the floor space required. Generally, floor space is based on square meters (square feet) per person working in the laboratory. Also necessary to consider are storage space, office space, and special areas dedicated to testing for specific parameters, as well as space for the installation of hoods, benches, cleanup stations, etc. In general, the flow of work in the laboratory should be considered in lab bench and equipment layout arrangement, with a minimum of people working in the same area at the same time. "Quiet" areas may need to be provided for some work assignments. Some states require a minimum laboratory square footage, particularly for bacteriological examinations. Each laboratory should comply with Federal OSHA regulations. Guidance on design of laboratories is available in USAEPA-2.

b. Materials. Acoustical tiles should be used for ceilings. Light colors are recommended for all interior walls. Floors should be either vinyl or rubber tile, and fire resistant as well as resistant to acids, alkalies, solvents, and salts. Doors should permit straight egress from the laboratory, and should have glass windows. All metals used in the construction of cabinets should be U.S. standard gauge 18 or better. All sheet metal should be coated with a corrosion-resistant finish. The shelf surface should be a smooth, hard, satin luster resistant to acids, alkalies, solvents, abrasives, and water. Stainless steel should be ANSI type 316 (OSHA 1996).

c. Utilities. The laboratory should be supplied with water, gas, air, and vacuum service lines and fixtures; traps, strainers, overflows, and plugs. Electrical service outlet fixtures should be convenient and adequate, preferably located on all laboratory walls.

d. Sinks. Generally, the laboratory should have one double-well sink with drain board. Sinks should be made of epoxy resin or plastic material with all appropriate appurtenances for laboratory applications. Water fixtures on which hoses may be used should be equipped with reduced-zone pressure backflow devices to prevent contamination of the water lines. Sinks should be highly resistant to acids, alkalies, solvents, salts, abrasives, and heat. Traps should be easily accessible.

e. Ventilation and lighting. Laboratories should be separately air conditioned, with external air supply providing 100 percent makeup volume. Separate exhaust ventilation should also be provided. Good lighting is also essential.

f. Power. To prevent line fluctuation, all electrical lines coming into the laboratory should be controlled with CVS harmonic neutralized-type transformers. For higher voltage requirements, the 220-volt lines should be regulated accordingly.

g. Gas. Natural gas should be supplied to the laboratory. Gas outlets should be placed in readily accessible locations.

h. Laboratory equipment. For minimum laboratory equipment requirements, see TM 5-814-3, Appendix F.

6-3. Sampling and Analysis

Proper operation of a wastewater treatment facility depends upon a well-defined and site-specific sampling and analysis program to monitor the performance of the treatment processes and ensure compliance with the regulatory requirements. For specific and general guidelines on sampling and analysis programs, see TM 5-814-3, Chapter 18. In addition, EM 200-1-3 provides guidance for preparing project-specific sampling and analysis plans (SAPs) for the collection of environmental data. For additional laboratory safety and health requirements, consult EM 385-1-1 and WEF MOP-1.

6-4. Flow Monitoring

a. Measurement devices. In conventional wastewater treatment plants, flow measurement is probably the most important element in collecting plant monitoring data. Primary flow measurement devices produce a hydraulic transition between subcritical and super-critical flow by resting the channel. Sharp-crested, broad-crested, V-notch, and proportional weirs can be used to measure flows accurately, but they tend to trap sediment and pollutants. Flumes are generally not affected by sedimentation or obstruction problems, particularly if they are located downstream of bar racks or other coarse screening devices. The most popular devices are Parshall flumes for open-channel applications and Palmer-Bowlus flumes for in-pipe flow measurement. Parshall flumes, the most often used wastewater flow measuring devices, have a lower head loss than a weir and a smooth hydraulic flow which prevents deposition of solids. Generally, Parshall flumes may be purchased in pre-fabricated forms with the necessary sonic or other measuring devices and recorders, which read both instantaneous flows and totalized daily flows.

b. Design formulas. Design formulas and tables for weirs, flumes, and flow monitoring equipment can be found in TM 5-814-3.